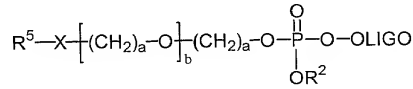
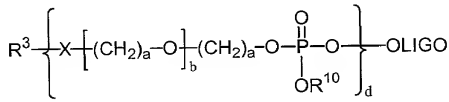
What is claimed is:

1. A mobility-modified sequence-specific nucleobase polymer comprising a mobility-modifying polymer linked to a sequence-specific nucleobase polymer, according to Structural formula (II) or (III):

(II)



(III)



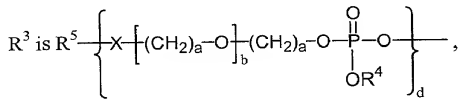
or a salt thereof, wherein:

R^2 is selected from the group consisting of alkyl comprising at least two carbon atoms, aryl, $(R^8)_3$ Si– where each R^8 is independently selected from the group consisting of linear and branched chain alkyl and aryl, base-stable protecting groups, and R^5–X–$[(CH_2)_a$–O$]_b$–$(CH_2)_a$–;

each R^{10} is independently selected from the group consisting of hydrogen and R^2;

R^5 is selected from the group consisting of hydrogen, protecting group, reporter molecule, and ligand;

R^3 is



each R^4 is independently selected from the group consisting of hydrogen and R^2;

each **X** is independently selected from the group consisting of O, S, NH and NH-C(O);

each **a** is independently an integer from 1 to 6;

each **b** is independently an integer from 0 to 40;

each **d** is independently an integer from 1 to 200; and

OLIGO is a sequence-specific nucleobase polymer,

with the proviso that at least one R^{10} or at least one R^4 is other than hydrogen.

2. The mobility-modified sequence-specific nucleobase polymer of Claim 1 in which each **X** is O.

3. The mobility-modified sequence-specific nucleobase polymer of Claim 1 in which each **a** is 2.

4. The mobility-modified sequence-specific nucleobase polymer of Claim 3 in which each **b** is 4.

5. The mobility-modified sequence-specific nucleobase polymer of Claim 1 in which OLIGO is a DNA, RNA, DNA analog, or RNA analog oligonucleotide.

6. The mobility-modified sequence-specific nucleobase polymer of Claim 1 in which OLIGO is an analog of a DNA or RNA oligonucleotide.

7. The mobility-modified sequence-specific nucleobase polymer of Claim 1 in which OLIGO comprises at least one non-negatively charged internucleotide linkage.

8. The mobility-modified sequence-specific nucleobase polymer of Claim 7, wherein said internucleotide linkage is a mono alkyl phosphate triester.

9. The mobility-modified sequence-specific nucleobase polymer of Claim 1 in which R^5 is a reporter molecule.

10. The mobility-modified sequence-specific nucleobase polymer of Claim 9 in which the reporter molecule is a fluorophore, a chemiluminescent moiety, or a ligand.

11. The mobility-modified sequence-specific nucleobase polymer of Claim 1 in which OLIGO includes a detectable label.

12. The mobility-modified sequence-specific nucleobase polymer of Claim 9 in which the detectable label is a fluorophore.

13. The mobility-modified sequence-specific nucleobase polymer of Claim 1 in which OLIGO comprises a polyethlyene oxide polymer.

14. The mobility-modified sequence-specific nucleobase polymer of Claim 13, wherein the polyethlyene oxide polymer is a mono methyl polyethlyene oxide polymer.

15. The mobility-modified sequence-specific nucleobase polymer of Claim 13, wherein the polyethlyene oxide polymer has a molecular weight of at least 2000 daltons.

16. The mobility-modified sequence-specific nucleobase polymer of Claim 13, wherein the polyethlyene oxide polymer has a molecular weight of at least 5000 daltons.

17. The mobility-modified sequence-specific nucleobase polymer of Claim 1, wherein the mobility-modifying polymer is attached to the 5'-end of the sequence-specific nucleobase polymer.

18. The mobility-modified sequence-specific nucleobase polymer of Claim 17, further comprising a polyethlyene oxide polymer attached to the 3'-end of the sequence-specific nucleobase polymer.

19. The mobility-modified sequence-specific nucleobase polymer of Claim 18, wherein the polyethlyene oxide polymer is a mono methyl polyethlyene oxide polymer.

20. The mobility-modified sequence-specific nucleobase polymer of Claim 18, wherein the polyethlyene oxide polymer has a molecular weight of at least 2000 daltons.

21. The mobility-modified sequence-specific nucleobase polymer of Claim 18, wherein the polyethlyene oxide polymer has a molecular weight of at least 5000 daltons.

22. The mobility-modified sequence-specific nucleobase polymer of Claim 1, wherein the mobility-modifying polymer is attached to the 3'-end of the sequence-specific nucleobase polymer.

23. The mobility-modified sequence-specific nucleobase polymer of Claim 22, further comprising a polyethlyene oxide polymer attached to the 5'-end of the sequence-specific nucleobase polymer.

24. The mobility-modified sequence-specific nucleobase polymer of Claim 22, wherein the polyethlyene oxide polymer is a mono methyl polyethlyene oxide polymer.

25. The mobility-modified sequence-specific nucleobase polymer of Claim 22, wherein the polyethlyene oxide polymer has a molecular weight of at least 2000 daltons.

26. The mobility-modified sequence-specific nucleobase polymer of Claim 22, wherein the polyethlyene oxide polymer has a molecular weight of at least 5000 daltons.

27. A composition comprising a plurality of mobility-modified sequence-specific nucleobase polymers, wherein each said nucleobase polymer is a compound according to Claim 1, and wherein each said nucleobase polymer has a distinctive ratio of charge to translational frictional drag.

28. The composition of Claim 27, wherein said each mobility-modified sequence-specific nucleobase polymer of said plurality comprises an OLIGO, and wherein each OLIGO has the same number of nucleobase units.

29. A method for detecting a plurality of selected nucleotide sequences within one or more target nucleic acids, comprising:

contacting at least one or more target nucleic acids with a plurality of mobility-modified sequence-specific nucleobase polymers under conditions that distinguish those nucleobase polymers that hybridize to the target nucleic acid, wherein each said nucleobase polymer is a compound according to Claim 1, and wherein each said nucleobase polymer has a distinctive ratio of charge to translational frictional drag; and

detecting those nucleobase polymer that have hybridized to the target nucleic acid.

30. The method of Claim 29, in which the OLIGO portions of the nucleobase polymers are composed of the same number of nucleobase units.

31. The method of Claim 29, wherein the one or more target nucleic acids are immobilized on a solid support.

32. The method of Claim 29, wherein each nucleobase polymer includes a detectable label.

33. The method of Claim 32, wherein the detectable label is a radioisotope, a chemiluminescent moiety, a fluorophore, or a ligand.

34. The method of Claim 29, wherein said detecting comprises the steps of:

recovering those nucleobase polymers that are hybridized to the target nucleic acid; and

separating the recovered nucleobase polymers by electrophoresis.

35. The method of Claim 34, wherein said electrophoresis is carried out by capillary electrophoresis in a non-sieving medium.

36. A method for detecting a plurality of selected nucleotide sequences within one or more target nucleic acids, comprising:

contacting the target nucleic acids with a first plurality of mobility-modified sequence-specific nucleobase polymer probes and a second plurality of sequence-specific nucleobase polymer probes under conditions that distinguish between those probes that hybridize to the target nucleic, wherein each mobility-modified sequence-specific nucleobase polymer is a compound according to Claim 1 and has a distinctive ratio of charge to translational frictional drag;

covalently joining first and second probes that adjacently hybridize to the same target nucleic acid molecules to form a ligation product, wherein each said ligation product has a distinctive ratio of charge to translational frictional drag; and

detecting said ligation products.

37. The method of Claim 36, wherein each ligation product comprises the same number of nucleobases.

38. The method of Claim 36, wherein the one or more target nucleic acids are immobilized on a solid support.

39. The method of Claim 36, wherein at least one of said first probe and said second probe includes a detectable label.

40. The method of Claim 39, wherein the detectable label is a radioisotope, a chemiluminescent moiety, a bioluminescent moiety, a fluorophore, or a ligand.

41. The method of Claim 40, wherein said detecting comprises the steps of:
recovering the ligation products; and
separating the recovered ligation products by electrophoresis.

42. The method of Claim 41, wherein said electrophoresis is carried out by capillary electrophoresis in a non-sieving medium.

43. The method of Claim 40, wherein the covalent joining is accomplished by a ligase.

44. The method of Claim 43, wherein the ligase is a thermostable ligase.

45. The method of Claim 44, wherein said contacting, hybridizing, joining, and releasing steps are repeated a plurality of times.

46. A method of separating a plurality of target nucleic acid molecules, comprising:

attaching a mobility-modified sequence-specific nucleobase polymer according to Claim 1 to each target nucleic acid of the plurality, thereby forming a plurality of mobility-modified target nucleic acids, wherein each target nucleic acid having the same number of nucleotide residues has a distinctive ratio of charge to translational frictional drag; and

fractionating the plurality of mobility-modified target nucleic acids.

47. The method of Claim 46, wherein said plurality of target nucleic acids is generated by a sequencing method selected from the group consisting of chain termination sequencing and chemical cleavage sequencing methods.

48. A method for detecting a plurality of selected nucleotide sequences within one or more target nucleic acids, comprising:

a) contacting the target nucleic acids with a plurality of nucleobase polymer primers whereby a first nucleobase polymer primer and a second nucleobase polymer primer each hybridize to complementary strands and at opposite ends of each of a plurality of selected nucleotide sequences, wherein at least one of each said first nucleobase polymer primer and said second nucleobase polymer primer is a mobility-modified sequence-specific nucleobase polymer according to Claim 3;

b) extending each said first nucleobase polymer primer and each said second nucleobase polymer primer with a DNA polymerizing activity in the presence deoxyribonucleoside triphosphate substrates;

c) denaturing the plurality of base-paired structures formed by base pairing interactions between each extended first nucleobase polymer primer and the target nucleic acid and each extended second nucleobase polymer primer and the target nucleic acid;

d) repeating steps (a) through (c) a plurality of times to form a plurality of polymerase chain reaction products, wherein each said polymerase chain reaction product has a distinctive ratio of charge to translational frictional drag; and

e) detecting said polymerase chain reaction products.

49. The method of Claim 48, wherein each said polymerase chain reaction product comprises the same number of nucleobases.

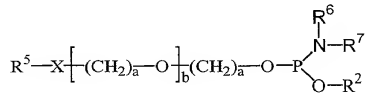
50. The method of Claim 48, wherein the one or more target nucleic acids are immobilized on a solid support.

51. The method of Claim 48, wherein at least one of said first nucleobase polymer primer, said second nucleobase polymer primer, or a substrate deoxyribonucleoside triphosphate comprises a detectable label.

52. The method of Claim 48, wherein said detecting comprises fractionation of said plurality of polymerase chain reaction products by capillary electrophoresis in a non-sieving medium.

53. A mobility-modifying phosphoramidite reagent having the structure:

(I)



wherein:

R^2 is selected from the group consisting of alkyl comprising at least two carbon atoms, aryl, $(R^8)_3$ Si– where each R^8 is independently selected from the group consisting of linear and branched chain alkyl and aryl, base-stable protecting groups, and R^5–X–$[(CH_2)_a$–O$]_b$–$(CH_2)_a$– ;

R^5 is selected from the group consisting of hydrogen, protecting group, reporter molecule, and ligand;

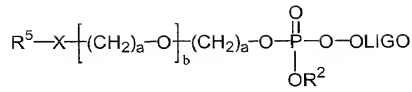
R^6 and R^7 are each independently selected from the group consisting of C_1 - C_6 alkyl, C_3 - C_{10} cycloalkyl, C_6 - C_{20} aryl, and C_{20} - C_{27} arylalkyl;

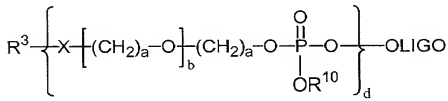
X is selected from the group consisting of O, S, NH, NH-C(O);

each **a** is independently an integer from 1 to 6; and

b is an integer from 0 to 40.

54. A kit comprising at least one mobility-modified sequence specific nucleobase polymer, wherein the mobility-modified sequence specific nucleobase polymer comprises a mobility-modifying polymer linked to a sequence-specific nucleobase polymer, according to structural formula (II) or (III):

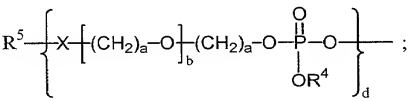
(II) 

(III) 

or a salt thereof, wherein:

R^2 is selected from the group consisting of alkyl comprising at least two carbon atoms, aryl, $(R^8)_3$ Si– where each R^8 is independently selected from the group consisting of linear and branched chain alkyl and aryl, base-stable protecting groups, and R^5–X–$[(CH_2)_a$–O$]_b$–$(CH_2)_a$– ;

R^5 is selected from the group consisting of hydrogen, protecting group, reporter molecule, and ligand;

R^3 is R^5—  ;

each R^{10} is independently selected from the group consisting of hydrogen and R^2;

each R^4 is independently selected from the group consisting of hydrogen and R^2;

each **X** is independently selected from the group consisting of O, S, NH and NH-C(O);

each **a** is independently an integer from 1 to 6;

each **b** is independently an integer from 0 to 40;

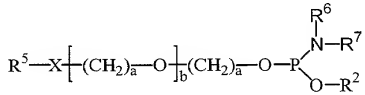
each **d** is independently an integer from 1 to 200; and

OLIGO is a sequence-specific nucleobase polymer,

with the proviso that if at least one R^{10} or at least one R^4 is not hydrogen.

55. A kit comprising at least one mobility-modifying phosphoramidite reagent, wherein said reagent has a structure according to:

(I)



wherein:

R^5 is selected from the group consisting of hydrogen, protecting group, reporter molecule, and ligand;

R^6 and R^7 are each independently selected from the group consisting of C_1 - C_6 alkyl, C_3 - C_{10} cycloalkyl, C_6 - C_{20} aryl, and C_{20} - C_{27} arylalkyl;

X is selected from the group consisting of O, S, NH, NH-C(O);

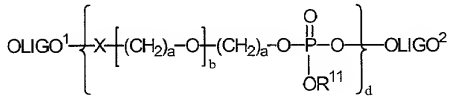
a is an integer from 1 to 6;

R^2 is selected from the group consisting of alkyl comprising at least two carbon atoms, aryl, $(R^8)_3$ Si– where each R^8 is independently selected from the group consisting of linear and branched chain alkyl and aryl, base-stable protecting groups, and R^5–X–$[(CH_2)_a$–O$]_b$–$(CH_2)_a$–; and

b is an integer from 0 to 40.

56. A mobility-modified sequence-specific nucleobase polymer comprising a mobility-modifying polymer linked to the 3'-end of a first sequence-specific nucleobase polymer and to the 5'-end of a second sequence-specific nucleobase polymer according to Structural formula (IV):

(IV)



or a salt thereof, wherein:

each R^{11} is independently selected from the group consisting of hydrogen, alkyl comprising at least two carbon atoms, aryl, $(R^8)_3$ Si– where each R^8 is independently selected from the group consisting of linear and branched chain alkyl and aryl, base-stable

protecting groups, R^5–X–$[(CH_2)_a–O]_b–(CH_2)_a$–, protecting group, reporter molecule, and ligand, with the proviso that at least one R^{11} is not hydrogen;

each **X** is independently selected from the group consisting of O, S, NH and NH-C(O);

each **a** is independently an integer from 1 to 6;

each **b** is independently an integer from 0 to 40;

d is an integer from 1 to 200;

$OLIGO^1$ is a first sequence-specific nucleobase polymer; and

$OLIGO^2$ is a second sequence-specific nucleobase polymer.

57. The mobility-modified sequence-specific nucleobase polymer of Claim 56 in which at least one of $OLIGO^1$ and $OLIGO^2$ comprises a polyethlyene oxide polymer.

58. The mobility-modified sequence-specific nucleobase polymer of Claim 57, wherein the polyethlyene oxide polymer is a mono methyl polyethlyene oxide polymer.

59. The mobility-modified sequence-specific nucleobase polymer of Claim 57, wherein the polyethlyene oxide polymer has a molecular weight of at least 2000 daltons.

60. The mobility-modified sequence-specific nucleobase polymer of Claim 57, wherein the polyethlyene oxide polymer has a molecular weight of at least 5000 daltons.